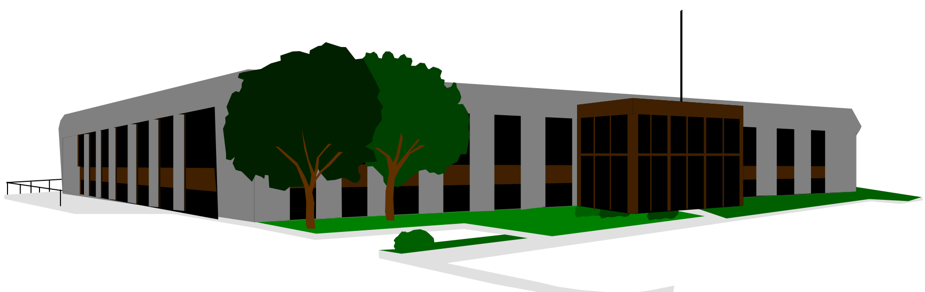
# INDOOR AIR QUALITY ASSESSMENT

**Lynch Elementary School**
**19 Brantwood Road**
**Winchester, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
July, 2000

## Background/Introduction

At the request of Frank Rowe, Principal, Lynch Elementary School the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Lynch Elementary School, Winchester, MA. On April 27, 2000, a visit was made to the school by Cory Holmes, Environmental Analyst for BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program, to conduct an indoor air quality assessment.

The school is a one-story brick on cement slab building constructed in the 1960's. The school contains general classrooms, music room, library, gymnasium, kitchen/cafeteria, auditorium, art room, several pre-school rooms and offices.

The building was previously evaluated by the Massachusetts Department of Labor and Workforce Development (MDLWD, 2000). The report indicated various problems related to lack of ventilation, poor building design and maintenance issues. In order to address indoor air concerns the school has adopted the Environmental Protection Agency's "Tools for Schools" (EPA, 1997) program and has instituted a "Tools for Schools" committee.

## Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer.

## Results

The school houses grades pre-kindergarten through fifth grade. It has a student population of approximately 400 and a staff of approximately 80. The tests were taken during normal operations at the school. Test results appear in Tables 1-4.

## Discussion

### Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million parts of air (ppm) in five of twenty areas surveyed, indicating a ventilation problem in these areas of the school. It is also important to note that a number of areas were sparsely populated or had open windows, which can greatly contribute to reduced carbon dioxide levels.

Fresh air in classrooms is supplied by a unit ventilator (univent) system (see Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building (see Picture 2) and return air through an air intake located at the base of each unit (see Figure 1). Fresh air and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Univents were deactivated in a number of classrooms surveyed (see Tables). Obstructions to airflow, such as books, papers and posters on top of univents, as well as bookcases, tables and desks in front of univent returns, were seen in a number of classrooms (see Picture 3). To function as designed, univents and univent returns must remain free of obstructions. Importantly, these units must be activated and allowed to operate during hours of school occupation.

The mechanical exhaust ventilation system consists of wall-mounted exhaust vents. As with the univents, a number of exhaust vents were obstructed by tables, chairs, boxes and other items (see Picture 4). The location of exhaust vents can also limit exhaust efficiency when the classroom hallway door is open (see Picture 5). When a classroom door is open, exhaust vents will tend to draw air from both the hallway and the classroom. The open hallway door reduces the effectiveness of the exhaust vent to remove common environmental pollutants from classrooms. Without removal by the exhaust ventilation, normally occurring environmental pollutants can build up and lead to indoor air complaints. A number of exhaust vents were noted to be deactivated, which can indicate that exhaust ventilation was turned off, or that rooftop motors were not functioning. BEHA staff examined exhaust motors on the roof and found a number of exhaust motors not operating (see Tables under "roof notes").

Exhaust vents in classrooms 117, 118 and 119 were all noted to be off. These three classrooms share a common exhaust motor, which is controlled by a timer (see Picture 6). Picture 7 shows exhaust vent ductwork that branches off to each classroom respectively. It is possible that this timer may be broken or malfunctioning, which has in turn deactivated the exhaust motor. In classroom 119 the exhaust vent is located on the wall behind the hallway door (see Picture 8). When this door is shut, the vent is clear. In an effort to improve airflow, some teachers will leave the classroom door open, which blocks the exhaust vent, interfering with the proper function of the system.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

The BEHA recommends that indoor air temperatures be maintained in a range between 70 $^{o}$ F to 78 $^{o}$ F in order to provide for the comfort of building occupants. Temperature readings in the school the day of the assessment were within the BEHA recommended range for comfort. A number of temperature control complaints were expressed to BEHA staff during the assessment, which may indicate problems with the pneumatic control system or that thermostats are out of calibration. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 21 to 30 percent, which is below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40-60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

**Microbial/Moisture Concerns**

Throughout the school, caulking around the interior and exterior windowpanes was crumbling, missing or damaged (see Picture 9). Several rooms contained loose fitting windowpanes and/or cracked or broken windows. Water vapor was observed collecting inside the double-paned window glass (see Picture 10). This indicates that the window's water seal is no longer intact. Several rooms also contained broken windows (see Tables). Repeated water damage can result in mold colonization of the wooden window frames and porous materials (e.g. curtains). Water damaged curtains are noted in Picture 11. Once mold has colonized, porous materials should be replaced as they are difficult to clean. Repairs of window leaks are necessary to prevent further water penetration. Repeated water damage can result in mold colonization of window frames, curtains and items stored on or near windowsills.

A number of rooms had water-stained ceiling tiles, which are evidence of historic roof or plumbing leaks. Ceiling tiles at the Lynch school are made of a non-porous material and are fixed directly to the ceiling by adhesive, therefore they are difficult to replace. It was reported by school personnel that the roof was replaced in 1995. No active roof leaks were reported/observed by BEHA staff during the assessment.

Pooling water was observed in a number of areas on the roof (see Picture 12). The freezing and thawing of water during winter months can lead to roof leaks and subsequent water penetration into the interior of the building. Pooling water can also become stagnant, which can lead to mold and bacterial growth, which can be introduced into the building by rooftop fresh air intakes. In addition, stagnant pools of water can serve as a breeding ground for mosquitoes.

Several classrooms contained plants. Plant soil and drip pans can serve as a source of mold growth. Plants were noted on top of univent fresh air diffusers (see Picture 1). Plants should be located away from univents and exhaust ventilation to prevent the aerosolization of dirt, pollen or mold.

Along the perimeter of the building, shrubbery and flowering plants were noted in close proximity to univent fresh air intakes (see Picture 13). Shrubbery and flowering plants can be a source of mold and pollen and should be placed and/or maintained to ensure that fresh air intakes remain clear of obstructions to prevent the entrainment of dirt, pollen or mold into the building.

The faculty lounge contained a water cooler on a carpeted floor; numerous un-capped, one-gallon plastic water jugs were noted on the carpet (see Pictures 14 & 15). Classroom 119 is a subterranean classroom, at the lowest point of the building. This area is carpeted and was reported to have a history of flooding. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

Water damage was noted on exterior doors and walls of the building along the foundation and brickwork (see Picture 16). Cracks between the foundation and the exterior wall can result in water penetrating into the building around the vapor barrier. Spaces beneath exterior doors can serve as a source of water entry into the building, causing water damage and potentially leading to mold growth.

Several classrooms have stuffed chairs, sofas and couches (see Picture 17). Many of these appeared to be stained, torn and/or in disrepair. Classroom 119 contained a couch, which had a musty odor. If old furniture and cushions become wet, they can provide a medium for mold growth, which is difficult to clean. In addition, old furniture and cushions can provide a reservoir for dusts and odors to accumulate.

The courtyard walls of the school are covered with ivy (see Picture 18). Clinging plants can cause water damage to brickwork by inserting tendrils into brick and mortar. Water can penetrate into the brick along the tendrils, which can subsequently freeze and thaw during the winter. This freezing/thawing action can weaken bricks and mortar, resulting in damage to this wall. In order to avoid this problem, clinging plants on brickwork is not recommended.

A number of areas had window-mounted air conditioning units. In several cases (i.e., the music room and pre-school classroom 7) spaces were observed around air-conditioning units, which provide a means of water penetration into the building. Musty odors were reported in classroom 7, which is a carpeted area. Carpeting in this room should be examined and removed if moldy.

**Other Concerns**

Several other conditions were noted during the assessment, which can affect indoor air quality. The art room (formally the kitchen area) contains a kiln equipped with local exhaust ventilation. The exhaust ductwork however appears to be tied in with the general exhaust for the cafeteria (see Picture 20). Pottery kilns can produce carbon monoxide and sulfur dioxide, which can cause respiratory symptoms in exposed individuals (McCann, M., 1985). The configuration of the kiln exhaust presents the opportunity for kiln emissions to enter occupied areas if the general exhaust is not activated. The kiln should be vented directly outside, not connected to the general exhaust.

The art room also contains a floor drain. Drain traps can dry out if not in use, allowing sewer gas to back up into occupied areas. Sewer gas can create nuisance odors and be irritating to certain individuals. This drain should be capped or wet regularly to prevent sewer gas back up.

The mailroom contains the computer mainframe, photocopier and transparency maker. No local exhaust ventilation was noted in this area. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). Photocopiers and computer equipment also give off excess heat. Without mechanical exhaust ventilation, excess heat, odors and pollutants produced by office equipment can build up. Several areas contained mimeograph machines and duplicating fluid (see Picture 22). In classroom 119, a number of containers of duplicating fluid were stored on the carpet (see Picture 15). Mimeograph duplicating fluid contains methanol (methyl alcohol), which is a volatile organic compound (VOC) that readily evaporates at room temperature. The off gassing of this material can be irritating to the eyes, nose and throat. Methanol is also a highly flammable material, which can be ignited by either flame or electrical source.

Flammable materials were also noted on the tabletop in the mailroom (see Picture 23). This area was open and unoccupied, allowing easy access for students. These materials should be stored properly and kept out of reach of students. In addition, flammable materials should be stored in a flameproof cabinet that meets the specifications of the National Fire Protection Association (NFPA, 1996).

As previously mentioned, many areas contained window-mounted air conditioners. Classroom 121 contained a portable air purifier. This equipment is normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

Accumulated chalk dust was noted in several classrooms (see Picture 24). Chalk dust is a fine particulate, which can be easily aerosolized and serve as an eye and respiratory irritant. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g. methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can also be irritating to the eyes, nose and throat. Exposed fiberglass pipe insulation was noted in classroom 116 (see Picture 25). Airborne fiberglass particles can serve as a skin and respiratory irritant to sensitive individuals.

Also of note was the amount of materials stored inside classrooms. In classrooms throughout the school, items were seen piled on windowsills, tabletops, counters, bookcases and desks. The large amounts of items stored in classrooms provide a source for dusts to accumulate. These items, (e.g. papers, folders, boxes, etc.) make it difficult for custodial staff to clean around these areas. Household dust can be irritating to eyes, nose and respiratory tract. These items should be relocated and/or should be cleaned periodically to avoid excessive dust build up.

Although no complaints of vehicle exhaust odors have been reported within the building, the potential for entrainment exists. Picture 26 illustrates the close proximity of the employee parking lot to the building and the potential for vehicle exhaust to be pulled into the univent fresh air intakes (called entrainment). Idling vehicles can result in the entrainment of vehicle exhaust into the building, which may, in turn, provide opportunities for exposure to compounds such as carbon monoxide. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Classroom 102 contained a number of animals including, a rabbit, turtle, frogs and lizards. The rabbit cage contained newspapers, which were soiled with rabbit wastes, and was located in close proximity to the univent return vent (see Picture 27). Porous materials (i.e., newspaper) can absorb animal wastes and can be a reservoir for mold and bacterial growth. Animal dander, fur and wastes can all be sources of respiratory irritants. Animals and animal cages should be kept away from the air stream of ventilation components to avoid the aerosolization of allergenic materials and/or odors.

Univents are equipped with filters that strain particulates from airflow. These filters provide minimal filtration of respirable dusts. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed in the univents. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent (Minimum Efficiency Reporting Value equal to 9) would be sufficient to reduce many airborne particulates (Thornburg, D., 2000; MEHRC, 1997; ASHRAE, 1992). Note that increasing filtration can reduce airflow (called pressure drop) which can reduce the efficiency of the univent due to increased resistance. Prior to any increase of filtration, each univent should be evaluated by a ventilation engineer to ascertain whether it can maintain function with more efficient filters.

## Conclusions/Recommendations

The conditions found in the Lynch Elementary School present a number of problems that require a series of remedial steps. For this reason a two-phase approach is required, consisting of immediate (**short-term**) measures to improve air quality within the school and **long-term** measures that will require planning and resources to adequately address overall indoor air quality concerns.

In view of the findings at the time of this assessment, the following **short-term** recommendations are made:

1. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
2. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.
3. Change filters for univents as per the manufacturer's instructions, or more frequently if needed. Clean and vacuum interior of univents prior to operation to avoid the re-aerosolization of accumulated dirt, dust and debris. Examine the

feasibility of installing a higher-grade filter in univents. Consider consulting a ventilation engineer prior to any increase in filter efficiency to evaluate univents.

4. Restore exhaust ventilation in classrooms and office space. Examine rooftop exhaust motors for proper function; repair and replace parts as needed. Examine timer controlling exhaust system in classrooms 117-119 for proper function; repair and recalibrate if necessary.

5. Remove all blockages from univents and exhaust ventilators to ensure adequate airflow. Close classroom hallway doors to maximize exhaust ventilation.

6. Once both the fresh air supply and exhaust ventilation are functioning, the systems should be balanced by a ventilation engineer.

7. Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort. Consider contacting an HVAC engineer concerning the repair and calibration of thermostats and pneumatic controls school-wide.

8. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

9. Ensure window mounted air conditioners are properly sealed to prevent water penetration and subsequent mold growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.
10. Move plants away from univents and ensure drip pans are placed underneath plants in classrooms. Examine plants in classrooms for mold growth in water catch basins. Disinfect water catch basins with an appropriate antimicrobial if necessary.
11. Examine carpeting for mold growth and remove/replace if moldy. Disinfect areas of floor underneath water-damaged carpeting with an appropriate antimicrobial.
12. Relocate or place tile or rubber matting underneath water coolers in carpeted areas.
13. Repair/replace broken windowpanes.
14. Install weather-stripping around exterior doors to prevent water intrusion.
15. Inspect plant growth outside perimeter of building periodically; trim plants away from fresh air intakes as needed.
16. Refrain from using the pottery kiln until equipment is provided with local exhaust ventilation independent of the general exhaust system.
17. Clean chalkboards and trays regularly to prevent the build-up of excessive chalk dust.
18. Encapsulate exposed pipe insulation to avoid the aerosolization of fiberglass fibers.
19. Seal drains in art room or pour water down regularly to prevent sewer gas back up.

20. Consider relocating photocopiers to a well-ventilated area or examine the feasibility of installing local exhaust ventilation.

21. Consider reducing or discontinuing use of mimeograph machines.

22. Have a complete inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers. Be sure all materials are labeled clearly.

23. Change filters in window-mounted air conditioners as per the manufacturer's instructions to prevent the re-aerosolization of dirt, dust and particulate matter.

24. Consider obtaining flameproof cabinets that meet NFPA requirements. Store flammable materials in the flameproof cabinets in a manner consistent with state and local fire codes.

25. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

26. Repair/replace loose/broken windowpanes and missing or damaged window caulking building-wide to prevent water penetration through window frames.

The following **long-term** measures should be considered:

1. Consider consulting a building engineer, hydrogeologist and/or an environmental engineering firm about possible options to eliminate water penetration into the building. Consider removal of carpeting in areas prone to flooding.
2. Inspect roof for proper drainage; consider consulting a building engineer about possible options to eliminate water pooling on roof.
3. Repair cracks/spaces around foundation of the building to prevent moisture penetration and subsequent water damage. Consider sealing the cement slab/brick wall junction to prevent water penetration.
4. Consider installing/restoring exhaust ventilation in the mailroom to help remove excess heat and odors generated by office and computer mainframe equipment.

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**Picture 1**

**Classroom Univent Note Flowering Plants near Air Diffusers**

**Picture 2**

**Univent Fresh Air Intake Noted on Exterior Courtyard Wall**

**Picture 3**


**Classroom Univent Note Return Vent is Obstructed by Bookcase**

**Picture 4**

**Classroom Exhaust Vent Obstructed with Items**

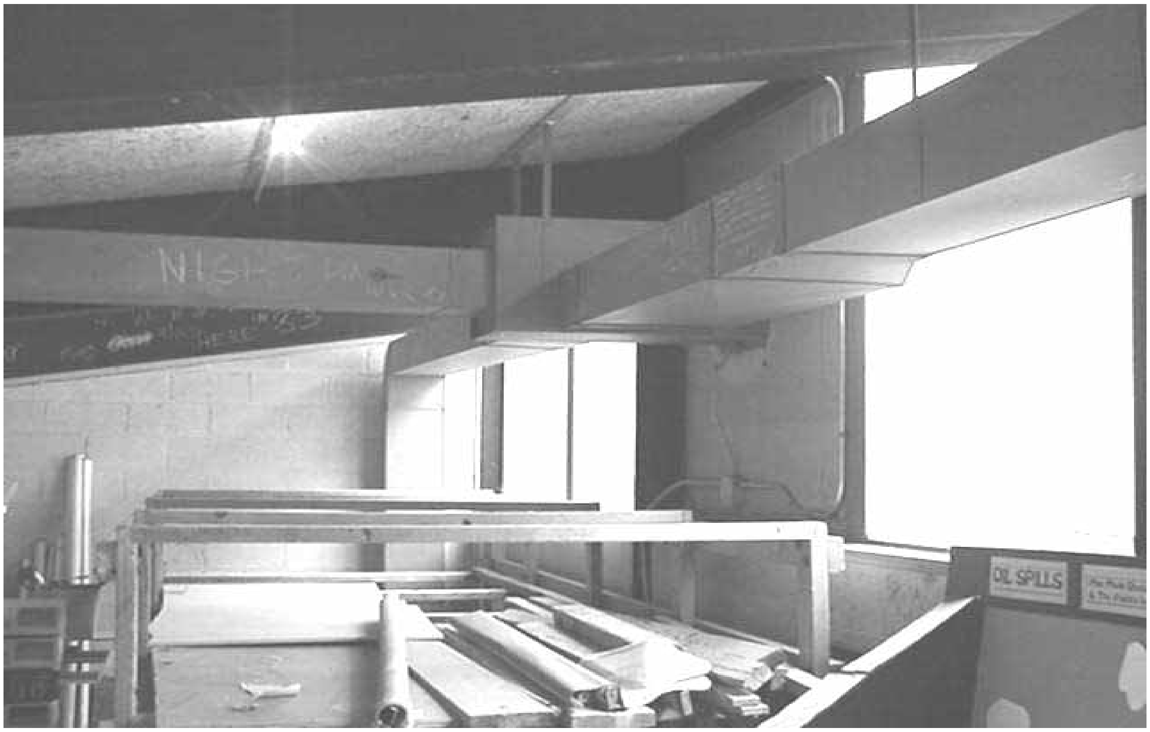
**Picture 5**

**Typical Classroom Configuration of Exhaust Vent and Classroom Door**
**Note Door to Hallway is open**

**Picture 6**


**Control Timer for Classroom Exhaust Vents (rooms 117-119)**

**Picture 7**




**Exhaust Ventilation Ductwork for Classrooms 117-119**
**Note Branching Ductwork Connected to Wall-mounted Exhaust Motor**

**Picture 8**


**Classroom Exhaust Vent Obstructed by Open Door**

**Picture 9**

**Loose Caulking Noted "Hanging" from Classroom Window**

**Picture 10**

**Water Trapped between Double-Paned Windows Indicating that the Seal is Compromised**

**Picture 11**

**Water-Damaged Curtains Noted in Classroom**

**Picture 12**

**Water Pooling on Roof Note Lack of Drainage in this Area**

**Picture 13**

**Univent Fresh Air Intake Obstructed by Shrubbery**

**Picture 14**

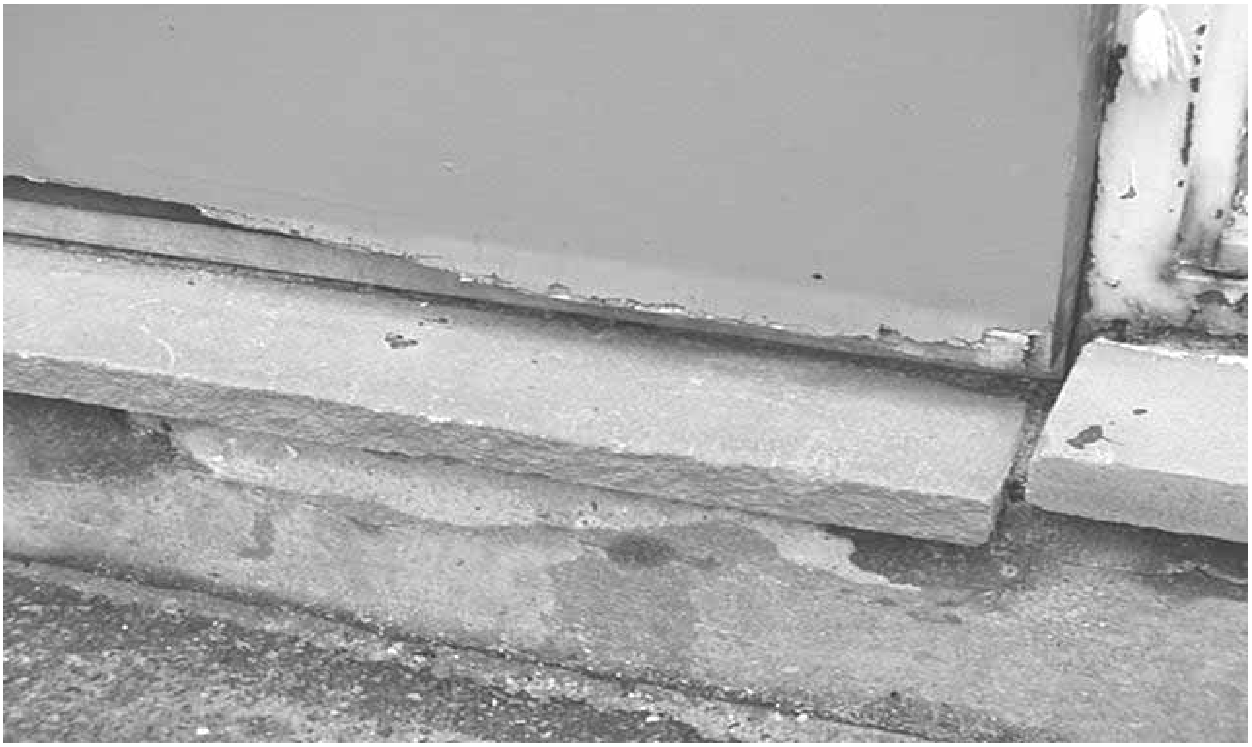
**Water Cooler Noted on Carpet in Teacher's Lounge**

**Picture 15**

flammables

**Uncapped One-Gallon Water Jugs Noted on Carpet**
**Also Note Flammable Materials and Mimeograph Machine**

**Picture 16**



**Water-Damaged Exterior Door and Window Frame**

**Picture 17**

**Furniture Noted in Classroom 119 Note Tears in Upholstery along Base and Cushions**

**Picture 18**

**Ivy Growth Noted on Exterior Wall of Courtyard**

**Picture 19**

**Window-Mounted Air Conditioning Units**

**Picture 20**

**Local Exhaust Ventilation for Kiln in Art Room, Ductwork Tied into the General Exhaust Ventilation for the Cafeteria**

**Picture 21**

**Floor Drain Noted in Art Room**

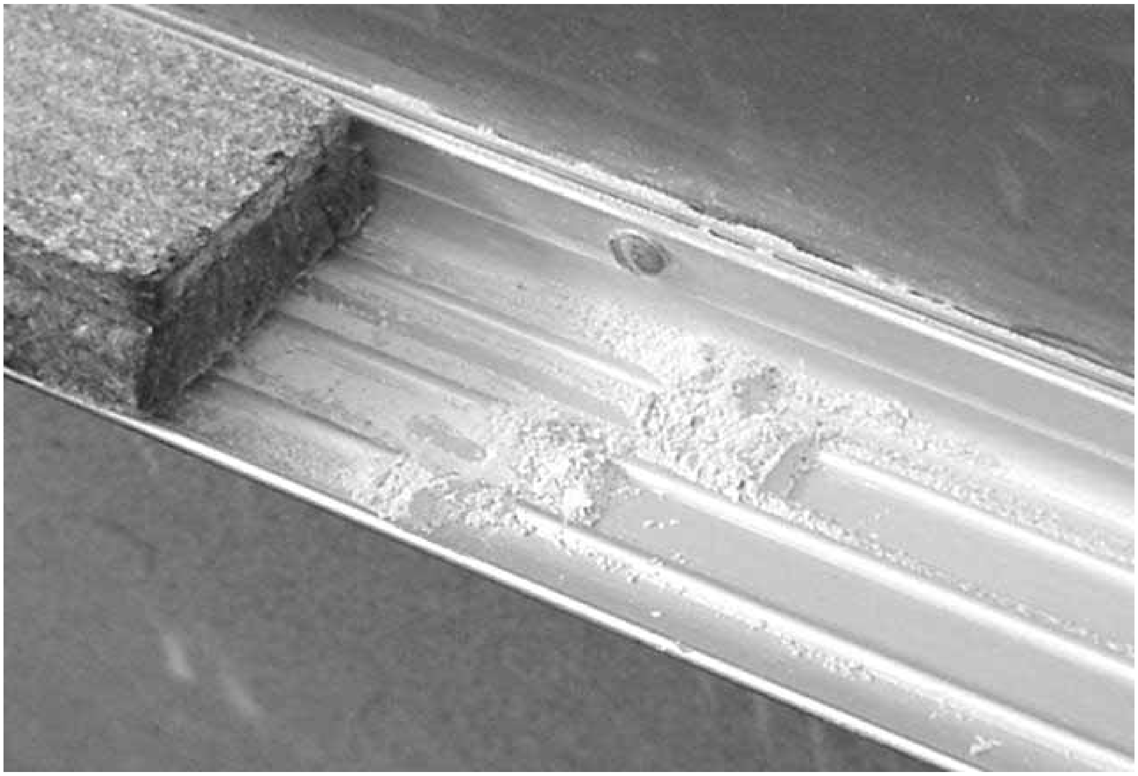
**Picture 22**

**Mimeograph Machine and Duplicating Fluid (Note Duplicating Fluid is a Flammable Material)**

**Picture 23**

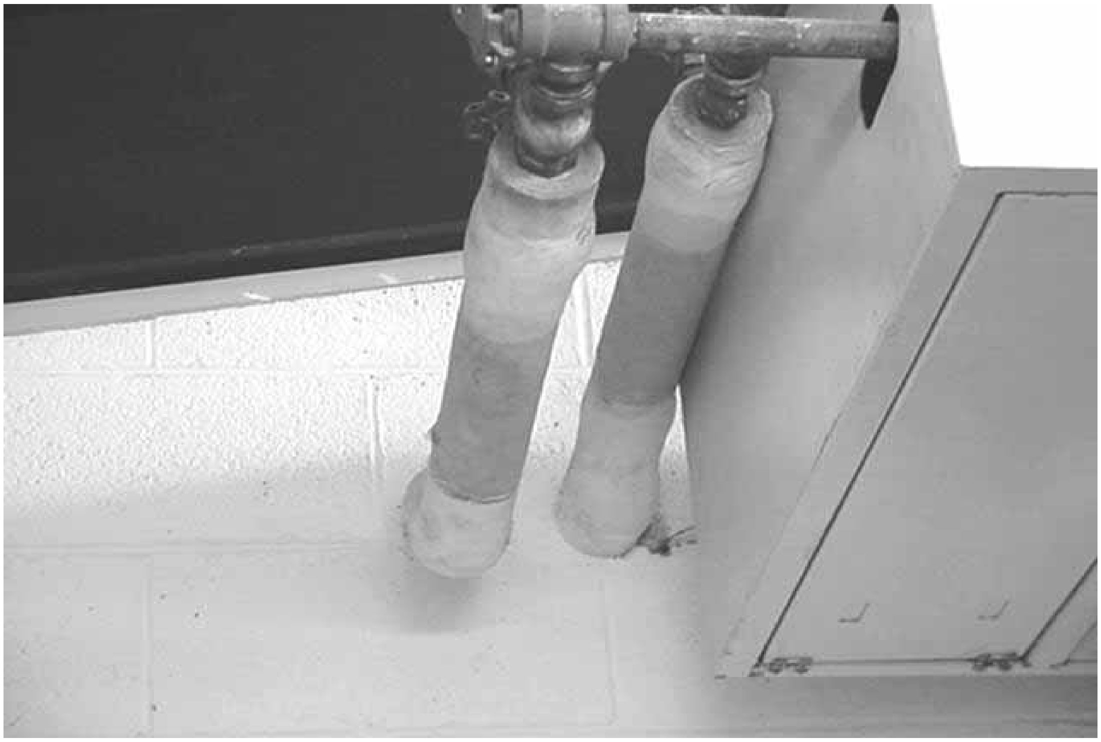

**Flammable Materials Noted on Tabletop in Mailroom Note Room was Open and Unoccupied at the Time**

**Picture 24**



**Accumulated Chalk Dust Noted in Classroom**

**Picture 25**

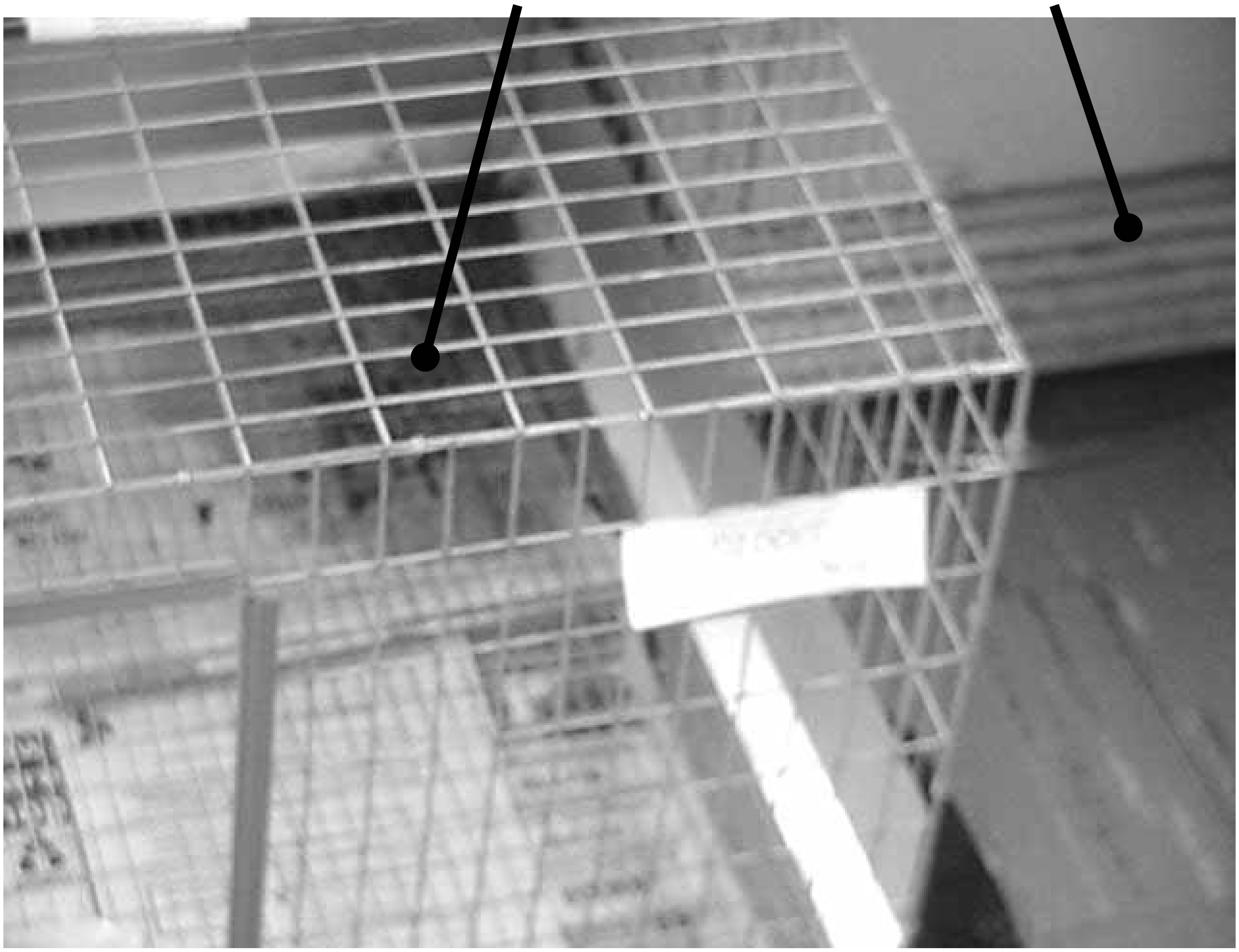


**Exposed Fiberglass Insulation**

**Picture 26**

**Vehicles Parked in Close Proximity ( ~ 2-3 Feet) to Univent Fresh Air Intake**

**Picture 27**




**Animal Cage in Close Proximity to Univent Return Vent**
**Note Newspapers Soiled with Animal Wastes**

TABLE 1

## Indoor Air Test Results –Lynch Elementary School, Winchester, MA – April 27, 2000

| Remarks | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Intake | Exhaust | |
| Outside (Background) | 434 | 54 | 60 | | | | | weather conditions: overcast, light breeze |
| Art Room | | | | 1 | yes | no | no | kiln ducted into general exhaust (cafeteria), floor drain, broken window |
| Gym | 604 | 71 | 30 | 18 | no | yes | yes | fresh air vents near ceiling |
| Classroom 101 | 493 | 70 | 27 | 13 | yes | yes | yes | univent deactivated due to noise-return blocked by pillows, exhaust off-motor malfunctioning, window open |
| Classroom 102 | 1147 | 73 | 30 | 23 | yes | yes | yes | turtles, frogs, rabbit-loose, lizards, door open |
| Classroom 103 | 787 | 75 | 26 | 0 | yes | yes | yes | exhaust vent blocked by table/waste basket, univent return blocked by bookcase, window and door open |
| Courtyard Interior | | | | | | | | missing/damaged caulking at windows/foundation-spaces, ivy growth-exterior wall |
| Boys' Restroom | | | | | | yes | yes | passive vent-missing |
| Room 16 – Mailroom | | | | 0 | no | yes | no | photocopier, transparency maker, main frame, broken ceiling panels, stained |

*** ppm = parts per million parts of air**

**Comfort Guidelines** **CEILING PANELS = water-damaged ceiling tiles**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

**TABLE 2**

## Indoor Air Test Results –Lynch Elementary School, Winchester, MA – April 27, 2000

| Remarks | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Intake | Exhaust | |
| | | | | | | | | ceiling panels, flammable-spray, door open |
| Room 5 – Payroll | 512 | 75 | 22 | 3 | yes | yes (2) | no | 2 window mounted air conditioners (a/c), photocopier, 3 water damaged ceiling panels, door open |
| Classroom 7 | 528 | 70 | 28 | 3 | yes | yes | yes | 2 window mounted a/c-leaks, 10+ water damaged ceiling panels, vent blocked by table/wastebasket, door open |
| Cafeteria | 770 | 77 | 30 | ~100(+) | yes | yes | yes | exhaust under stage |
| Classroom 104 | 930 | 76 | 28 | 20 | yes | yes | yes | chalk dust, door open |
| Faculty Lounge | 691 | 77 | 22 | 5 | yes | no | no | water cooler on carpet, broken window, window open |
| Faculty Restroom Men | | | | | | | yes | |
| Faculty Restroom Women | | | | | | | yes | |
| Room 15-Music | 641 | 76 | 23 | 25 | yes | yes (2) | yes | window mounted a/c, caulking-loose/hanging, plants on univent |

*** ppm = parts per million parts of air**
**CEILING PANELS = water-damaged ceiling tiles**

**Comfort Guidelines**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

TABLE 3

## Indoor Air Test Results –Lynch Elementary School, Winchester, MA – April 27, 2000

| Remarks | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Intake | Exhaust | |
| Classroom 125 | 618 | 78 | 24 | 6 | yes | yes | yes | plants on univent |
| Classroom 124 | 639 | 78 | 23 | 7 | yes | yes | yes | |
| Room 122-Computer Room | 609 | 77 | 21 | 1 | no | yes | yes | 10+ computers, laminator, ceiling mounted univent, interior room |
| Classroom 115 | 638 | 76 | 23 | 19 | yes | yes | yes | 2 wall mounted local exhaust vents, door open, former home ec. room-2 sinks-shut off |
| Classroom 121 | 595 | 75 | 24 | 17 | yes | yes | yes | air purifier |
| Classroom 120 | 860 | 76 | 27 | 10 | yes | yes | yes | items on univent-fan off, cars parked near air intake, door open |
| Classroom 119 | 1455 | 73 | 28 | 19 | yes | yes | yes | univent off, ceiling mounted a/c, mimeograph, 2 transparency makers, flammables on carpet, 50+ plants, uncapped water jug on carpet, exhaust vent behind door, door open, chalk dust, lowest point of building-history of flooding, carpet |

*** ppm = parts per million parts of air**

**Comfort Guidelines** **CEILING PANELS = water-damaged ceiling tiles**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |

TABLE 4

## Indoor Air Test Results –Lynch Elementary School, Winchester, MA – April 27, 2000

| Remarks | Carbon Dioxide *ppm | Temp. °F | Relative Humidity % | Occupants in Room | Windows Openable | Ventilation Intake | Ventilation Exhaust | Remarks |
|---|---|---|---|---|---|---|---|---|
| Classroom 116 | 1200 | 73 | 27 | 21 | yes | yes | yes | univent and exhaust off, exposed fiberglass-end of insulation |
| Library | 568 | 72 | 25 | 0 | yes | yes (2) | yes | door open |
| Classroom 126 | 559 | 74 | 25 | 5 | yes | yes | yes | window and door open, heat complaints |
| Roof Notes | | | | | | | | standing water-2”-3” in some areas, exhaust fans #9 and #10 and unlabeled fan (near cafeteria) off |

*** ppm = parts per million parts of air**

**Comfort Guidelines**

**CEILING PANELS = water-damaged ceiling tiles**

| | |
|---|---|
| Carbon Dioxide - | < 600 ppm = preferred |
| | 600 - 800 ppm = acceptable |
| | > 800 ppm = indicative of ventilation problems |
| Temperature - | 70 - 78 °F |
| Relative Humidity - | 40 - 60% |